

# **ANALYZING INFLATION TARGET MISSES**

A Master's Thesis

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September 2010

**ANALYZING INFLATION TARGET MISSES**

The Institute of Economics and Social Sciences  
of  
Bilkent University

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In Partial Fulfillment of the Requirements for the Degree of  
MASTER OF ARTS

in

THE DEPARTMENT OF  
ECONOMICS  
BİLKENT UNIVERSITY  
ANKARA

September 2010

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ABSTRACT  
ANALYZING INFLATION TARGET MISSES

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September 2010

This thesis identifies the roles of both domestic and global factors in missing the inflation targets with the help of Arellano-Bond fixed effects estimation. Central bank credibility has the largest absolute effect on target misses; exchange rate and fiscal surplus ratio to GDP have the medium absolute effect on target misses. Oil prices seem to have significant but limited effect. This thesis also examines whether there is any difference in the formation of inflation expectations when countries miss their inflation targets with the help of linear ordinary least squares estimation. The results may suggest that when CB does not achieve its target, the total weight put on the lagged inflation will be higher than that of the inflation target. Thus, in this analysis, inflation target misses are causing inflation inertia which leads to a more costly disinflationary monetary policy in the short run. Furthermore, there is some evidence of the asymmetry between inflation target misses in the sense that the weights put on overshooting and undershooting are not the same.

*Keywords:* Inflation target misses, inflation expectations, emerging market economies.

## ÖZET

### ENFLASYON HEDEFİNDEN SAPMALARIN ANALİZİ

Kırımhan, Destan

Yüksek Lisans, Ekonomi Bölümü

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Eylül 2010

Bu yüksek lisans tezi Arellano-Bond sabit etkiler tahmin yöntemi yardımıyla hem iç hem de küresel faktörlerin enflasyon hedefinden sapmalar üzerine etkilerini belirlemektedir. Hedeften sapmalar üzerinde Merkez Bankası kredibilitesi en fazla; döviz kuru ve mali fazlanın GSYİH'ya oranı orta derecede mutlak etkiye sahiptir. Petrol fiyatlarının önemli ama sınırlı etkisi vardır. Bu tez ayrıca, doğrusal sıradan en küçük kareler yöntemi yardımıyla ülkeler enflasyon hedeflerini kaçırdıklarında enflasyon beklentilerinin oluşturulmasında herhangi bir farklılık olup olmadığını incelemektedir. Sonuçlar, Merkez Bankası'nın hedefi tutturamadığı zaman gecikmeli enflasyona verilen toplam ağırlığın enflasyon hedefine verilenden daha fazla olabileceğini ileri sürmektedir. Bu nedenle, bu analizde, enflasyon hedefinden sapmalar kısa vadede daha maliyetli dezenflasyonist bir para politikasına yol açan enflasyon ataletine neden olmaktadır. Bunun yanı sıra, hedefin üstündeki sapmalar ile altındaki sapmalara verilen ağırlığın aynı olmaması bakımından enflasyon hedefinden sapmalar arasında bir asimetri olduğuna yönelik kanıt bulunmaktadır.

*Anahtar Kelimeler:* Enflasyon hedefinden sapmalar, enflasyon beklentileri, gelişmekte olan ekonomiler.

## **ACKNOWLEDGMENTS**

I would like to express my sincere gratitudes to;

Ümit ÖZLALE, for his excellent guidance, valuable suggestions, encouragements and infinite patience,

Erinç YELDAN, for guiding and believing in me and providing support whenever I needed,

Refet GÜRKAYNAK, for his valuable suggestions and support,

The Scientific and Technological Research Council of Turkey (TÜBİTAK) for providing me a satisfactory scholarship for my research,

My mother and father, for their continuous support and patience.

Finally, Emir ACUNKAYA and Şule TAŞÇIER, for their support and amity.

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# **CHAPTER 1**

## **INTRODUCTION**

Inflation targeting is a monetary policy regime that requires announcements of official inflation targets and acceptance that the primary long run objective of monetary authority to maintain price stability. New Zealand was the initiator of inflation targeting regime in 1990 and then several industrialized countries put this regime into practice. Emerging market economies began to adopt inflation targeting regime in 1991 with the initiation of Chile.

The performance of inflation targeting countries on lowering inflation is positive. Average inflation for inflation targeters has declined from 38.8% to 4.9% from pre-targeting period to post-targeting period.<sup>1</sup> Average inflation for non-targeters has declined from 14% to 7.3% from pre-targeting period to post-targeting period when the average date of targeters is taken as the date of targeting for non-targeters. Therefore, average inflation has decreased by 87% for targeters whereas 47.4% for non-targeters. (Figure 1.1)

However, the average inflation in emerging market economies (EMEs) is not as low as that of industrialized economies (INDs). Before inflation targeting, the

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<sup>1</sup> These calculations are done with the data taken from the IMF database.

average inflation in INDs was 8.8%, whereas after the adoption of inflation targeting, it declined to 2.7%. Before inflation targeting, the average inflation in EMEs was 57.3%, whereas after the adoption of inflation targeting, it declined to 6.2%. (Figure 1.2) Thus, the substantial decrease in inflation for EMEs is not enough to match the low inflation numbers observed in INDs.

In addition, the deviations of actual inflation from the target inflation are considerably higher in EMEs compared to those of INDs. Average inflation target misses in INDs for the period of 2002-2009 is -0,2 whereas it is 0,8 for EMEs (Figure 1.3). Thus, inflation target misses is an emerging market economy phenomenon. Moreover, absolute average inflation target misses in INDs for the period of 2002-2009 is 0,8 whereas it is 1,8 for EMEs. (Figure 1.4)

The factors that cause inflation target misses for EMEs are the main focus of this chapter. This study investigates the roles of country-specific and global factors on causation of inflation target misses in EMEs with the help of a fixed effects estimation procedure. The motivation behind this idea is that by knowing the underlying factors that cause inflation target misses, Central Banks can intervene to reduce or eliminate the effect of that specific factor and by this way, inflation target can be achieved and the credibility of the inflation targeting regime can be increased.

The results suggest that central bank credibility has the largest absolute effect on target misses with the coefficient of 0,34. Then, exchange rate and fiscal surplus ratio to GDP have the medium absolute effect on target misses with a total coefficient of 0,043. The smallest effect belongs to the global factor which is the world fuel oil prices with 0,02.

The next chapter is organized as follows. The first section presents the aforementioned country-specific and global factors that can cause inflation target

misses by past papers. The second section presents the methodology and the model which is employed to capture the importance levels of country-specific and global factors for inflation target misses. The third section introduces the data used in the analysis. The fourth section discusses the estimation results and the last section concludes.

## **CHAPTER 2**

### **ROLES OF FACTORS IN MISSING INFLATION TARGETS**

#### **2.1 Literature Review**

The country-specific and global factors that cause inflation target misses are mentioned separately in this paper. First, the country-specific factors are taken into consideration.

The most common factor signalized in the past papers as causing inflation target misses is exchange rate movements. Roger and Stone (2005) and Gosselin (2007) have indicated that large misses are often caused by exchange rate shocks in both the EMEs and INDs.

Furthermore, Fraga, Goldfajn and Minella (2003) have stated that EMEs are more prone to sudden stops in capital inflows that affect the exchange rate and in turn the inflation rate.

Another common factor aforementioned in the past papers is the fiscal dominance. Mahadeva and Sterne (2000) and Fraga, Goldfajn and Minella (2003) have stated that the attempts to impose discipline on fiscal policy are important for the performance of the Central Bank. Gosselin (2007) have mentioned that the inflation deviations are positively correlated with fiscal deficits. Moreover, Mishkin

(2000) have indicated that absence of fiscal dominance is a key prerequisite for inflation targeting since large fiscal deficits will gradually eroded by a large depreciation which is followed by a high inflation. Kumhof (2001) have indicated that countries that are planning to adopt inflation targeting regime should realize the need of achieving and sustaining fiscal discipline and prevent large exchange rate fluctuations.

Another common factor is the credibility of the monetary authority. Fraga, Goldfajn and Minella (2003) have indicated that the expected and in turn the actual inflation are prone to be larger with the imperfect credibility than that of with the perfect credibility. Also, the inflation volatility is more likely to be higher compared to that of with the perfect credibility. Nahon and Meurer (2009) have stated that in inflation targeting regimes, to decrease the inflation to the target level, agents must believe that the central bank commits to the target. Thus, the credibility of the central bank is important for recording low inflation.

The last common factor is the independence of the monetary authority. Gosselin (2007) have stated that the inflation deviations are negatively correlated with central bank independence.

Second, the global factors are taken into consideration.

The most common factor signalized in the past papers as causing inflation target misses is the world oil prices. Roger and Stone (2005) have indicated that all of the countries are vulnerable to changes in world fuel prices and added that overshooting the inflation targets are caused by higher fuel prices brought by higher world import prices in Poland in 2000. Furthermore, Batini and Tereanu (2009) have stated that the supply shock generating high oil prices disseminate to headline CPI in most countries, however net importers of oil were affected most. Neumann and

Hagen (2002) have done a study that compares inflation rates after the 1978 and 1998 oil price shocks and concluded that inflation targeting central banks gained more credibility than those of the non-inflation targeting countries.

Another common factor is the food prices. Roger and Stone (2005) have indicated that an increase in food prices caused an overshooting in South Africa in 2003.

Mishkin and Savastano (2000) have indicated that inflation targeting ensures monetary policy to put weight on domestic factors and to react to both the domestic and the global shocks. Holub and Hurnik (2008) have estimated a set of VAR models for Czech Republic and found that the shock to food prices has the largest impact on financial markets' inflation expectations and the reaction of inflation expectations to commodity price shocks is significant. Furthermore, exchange rate shocks have a greater impact than commodity price shocks. Roger (2009) has indicated that in the adoption period of inflation targeting regime by most of the countries, global macroeconomic conditions such as global commodity prices and financial shocks have been stable relative to past periods. Therefore, there is a little evidence that the inflation targeting regime is robust to global shocks. Roger has also stated that inflation targeting countries minimized the inflationary effects of increases in the commodity prices in 2007 better since central banks put a large weight on inflation and thus, inflation expectations were anchored well.

Mishkin and Schmidt-Hebbel (2001) have estimated a multivariate probit model for the probability of adopting inflation-targeting regime, based on the variables that are monetary growth, the fiscal surplus ratio to GDP, exchange rate band width, central bank independence. That paper examines the relationship between the likelihood of adopting inflation-targeting regime and the country-



specific factors. However, in this analysis, the relationship between the inflation target misses and both the country-specific and global factors is examined.

Gosselin (2007) have estimated a fixed effects model to investigate the effect of exchange rate movements, fiscal deficits and differences in financial sector development to the deviations from inflation targets. That paper lacked of the global factors and the past period's inflation target misses as the proxy for the central bank credibility. However, in this analysis, the global factors are utilized and the importance levels of the country-specific, domestic and global factors that are central bank credibility, exchange rate and fiscal surplus ratio to GDP and oil prices, respectively are found. These findings may guide central banks in determining the weights put on different domestic and global factors and how to react to those factors.

## **2.2 The Model and Methodology**

The estimation procedure used in this study to investigate the roles of country-specific and global factors on inflation target misses in EMEs is fixed effects since in the data, there are some domestic factors that are subject to change in time, some country-specific factors that are constant in time which represents the unobserved heterogeneity among countries and some global factors that are subject to change in time but fixed among countries. Arellano-Bond dynamic panel data estimation procedure under fixed effects is employed since lag of the dependent variable is used as an explanatory variable in the model.

### 2.2.1 The Model

The general representation of the fixed effects model in this chapter is as follows:

$$Y_{it} = \beta X_{it} + \gamma_t + u_{it}$$

where  $X_{it}$ 's includes both the country-specific and domestic factors that are central bank credibility, exchange rate and fiscal surplus ratio to GDP, respectively,  $\gamma_t$ 's are the global factors that are subject to change in time but fixed among countries that is world oil prices and  $u_{it}$ 's are the idiosyncratic error terms.

Therefore, the model in this chapter will be as follows:

$$ITM_{it} = \beta_1 [EX_{it} FIS_{it}] + \beta_2 [OIL_t] + \beta_3 [ITM_{it-1}] + u_{it}$$

where  $i$  is the country indicator,  $t$  is the time indicator, ITM is inflation target miss, EX is exchange rates, FIS is fiscal surplus ratio to GDP, OIL is the world fuel oil prices, and ITMit-1 is the one period lagged inflation target miss that is used as a proxy for the central bank credibility.

In this model specification, since the cross correlation between world food prices and world fuel oil prices is 0,96 which is high enough to cause a multicollinearity problem, only the world oil prices are employed.

## 2.3 Data

Annual actual and target inflation, exchange rates, fiscal surplus and GDP for 12 inflation targeter EMEs that are Brazil, Chile, Colombia, Hungary, Israel, Mexico, Peru, Poland, South Africa, South Korea, Thailand and Turkey for the period of 2003-2008 are utilized. Furthermore, annual world food and fuel oil prices are

employed for the period of 2003-2008.

All data are available at IMF database and the central banks of each country.

## 2.4 Estimation Results

The estimation results of the model are presented in the Table 4.7 in the appendix. All of the coefficients are statistically significant at the 10% significance level and the signs are as expected. The coefficient of past period's target miss indicates that 1% increase in the past period's target miss causes a 0,34% increase in the current period's target miss. Thus, there seems to be inertia in inflation target misses. The effect of 1% increase in the exchange rate (i.e. the depreciation of domestic currency) on the current period's target miss is 0,003% which is the exchange rate pass through coefficient. The effect of 1% increase in the fiscal surplus ratio to GDP on the current period's target miss is -0,04% meaning that budget deficits can explain the inflation target misses.<sup>2</sup> The coefficient of world fuel oil prices indicates that 1% increase in the world fuel oil prices causes a 0,02% increase in the current period's target miss by increasing the cost of production.

Country-specific factor which is the Central Bank credibility criterion in this model has the largest absolute effect on target misses with the coefficient of 0,34. Then, the domestic factors that are subject to change in time which are the exchange rates and fiscal surplus ratio to GDP in this model have the medium absolute effect on target misses with a total coefficient of 0,043. The smallest effect belongs to the global factor which is the world fuel oil prices with 0,02.

Note that  $R^2$  and the adjusted  $R^2$  are negative. However, negative  $R^2$  can be

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<sup>2</sup> It may well be the case that a supply shock can affect the two variables and cause a spurious relation.

observed when the instrumental variable approach is used because the aim of this method is to get accurate estimates of the coefficients but  $R^2$  indicates only how well the data is fit.

Note also that there are J-statistic and instrument rank. The J statistic is simply the Sargan test statistic that is the value of the GMM objective function at estimated parameters. Here, since the instrument rank of 18 is greater than the number of estimated coefficients (4), the J statistic of 27,33487 can be used to construct the Sargan test of over-identifying restrictions.

Under the null hypothesis that all of the instruments are strong, the Sargan statistic is distributed as a chisquare where the degrees of freedom is the difference between the number of estimated coefficients and the instrument rank. The p-value of this model is found as 0,017<sup>3</sup> which indicates a very small probability to reject the null hypothesis. Thus, the results may suggest that the model is statistically significant at the 5% significance level and all of the instruments are strong.

## 2.5 Conclusions

The performance of inflation targeting countries on lowering inflation is positive. However, the average inflation in emerging market economies (EMEs) is not as low as that of industrialized economies (INDs). In addition, the deviations of actual inflation from the target inflation are considerably higher in EMEs compared to those of INDs. The differences between the performances of inflation target regime of EMEs and INDs are the main focus of this paper. Thus, in this chapter of the paper, the roles of both country-specific and global factors in missing the inflation targets

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<sup>3</sup> The p-value can be found as  $p\text{-value} = \text{chisquare}_{|\text{number of estimated coefficients} - \text{instrument rank}|} (\text{J statistic}) = \chi^2_{27,33487(14)} = 0.017$

with the help of Arellano-Bond fixed effects estimation are identified for EMEs in the period of 2003-2008.

Country-specific factor in the model is the last period's target miss which is used as a proxy variable for Central Bank credibility criterion and the global factor is the world fuel oil prices. There are also domestic factors that are subject to change over time which are exchange rates and fiscal surplus ratio to GDP.

Central bank credibility has the largest absolute effect on target misses with the coefficient of 0,34. Then, exchange rate movements and fiscal surplus ratio to GDP have the medium absolute effect on target misses with a total coefficient of 0,043. The smallest effect belongs to the global factor which is the world oil prices with 0,02.

Monetary authority is not expected to respond to global factors such as oil prices, which are exogenous. However, central banks can affect exchange rates of their currencies and their credibility by achieving inflation targets. Besides, the coordination between the fiscal and monetary policy is important since if government produces fiscal deficits for a long time, there will be most probably inflation target misses and the influential level of monetary policy will be limited with the level of fiscal tightness. From the Box 1 titled as "Analyzing the Dynamics of Two Successful Inflation Targeters", it cannot be suggested that there is a general statement that the successful inflation targeters have budget deficits or surpluses. Yet, the Brazilian experience shows that successful inflation targeters may give budget surpluses and Switzerland experience displays that if inflation targeters give budget deficits, they set some constitutional mechanisms aiming to eliminate structural deficits to be successful.

## **CHAPTER 3**

### **EFFECTS OF TARGET MISSES ON INFLATION EXPECTATIONS**

In Chapter 2, the roles of both the global and the country-specific factors in missing inflation targets were specified. These factors cause deviations of actual inflation from the target inflation and thus create a credibility loss. It may well be the case that in a country where its central bank is not credible, people will gradually form their inflation expectations by attaching more importance to past inflations and less to official inflation targets. Thus, this will lead to inflation persistence. By this way, the link between the inflation target misses and loss of credibility will be strengthened.

This chapter examines whether there is any difference in the forming of inflation expectations when countries miss their inflation targets. The motivation behind this idea is that after inflation target misses if people give more weight to past inflations when forming their inflation expectations, there will be inflation inertia which will lead to a more costly disinflationary monetary policy.

To examine whether there is any difference in the formation of inflation expectations when countries miss their inflation targets, both the linear OLS and the panel generalized method of moments for the same model specification is employed.

Besides this main model specification, another model specification that uses the absolute value of inflation target misses is employed to check whether there is any evidence of the asymmetry between inflation target misses.

The results may suggest that when CB does not achieve its target, the total weight put on the lagged inflation will be higher than that of the inflation target. Thus, for the seven years period of 2003-2009 and for the countries in this analysis, inflation target misses are causing inflation inertia which leads to a more costly disinflationary monetary policy in the short run.

Furthermore, there is an important point to mention that when CB does not achieve its target, the amount of decrease in the weight put on inflation target (0,03) is higher than the amount of increase in the weight put on lagged inflation (0,02). Therefore, the total weight that can cause inflation inertia year by year is 0,05 on the assumption that parameters are statistically significant.

When the results of the absolute value model is compared with those of the level model, there is some evidence of the asymmetry between inflation target misses in the sense that the weights put on overshooting and undershooting are not the same.

This chapter is organized as follows. The first section presents the past literature about the effects of inflation target misses on expectation formations. The second section presents the methodology and the model which is employed. The third section introduces the data used in the analysis. The fourth section discusses the estimation results and the last section concludes.

### **3.1 Literature Review**

Little and Romano (2009) have stated that for inflation targeting countries, the

inflation target may serve to anchor expectations whereas in non-inflation targeting countries lagged inflation may serve that role and the ability of inflation targeting to help control inflation expectations stems from the premium it places on improving transparency standards. However, Laubach and Posen (1997) have indicated that both in Canada and New Zealand, it seems plausible to model lagged inflation as a determinant of private sector inflation expectations. Thus, inflation targeting regime does not seem to cause a revolution in expectation formation in Canada and New Zealand whereas in Germany and Switzerland, due to the confidentially proven inflation targeting regime, inflation expectations display a high degree of inertia caused by the limited upswing moves of inflation after shocks and the pace of response to disinflation.

Pétursson (2004) has marked that inflation targeting has reduced inflation persistence and thus inflation expectations are more forward looking after the introduction of inflation targeting. Moreover, according to Pétursson, it has also increased the credibility of monetary policy. Furthermore, Corbo, Landerretche and Schmidt-Hebbel (2001) have indicated that inflation targeting strengthen the impact of forward-looking expectations on inflation, thus weakened the weight put on the past inflation inertia. Moreover, Levin, Natalucci and Piger (2004) have stated that inflation targeting displayed a role in keeping long run inflation expectations in control and in decreasing the persistence of inflation showing that five inflation targeters that are Australia, Canada, New Zealand, Sweden and United Kingdom have delinked inflation expectations from the actual inflation.

Fraga, Goldfajn and Minella (2003) have stated that there are two main obstacles for reducing inflation. One of them is the imperfect credibility of central bank and the other is the presence of some degree of inflation persistence that is



caused by some backward-looking behavior in price setting. They also marked that in the case where aggregate supply is more forward-looking, if there is a reduction in the inflation target, inflation converges to new target automatically.

Nahon and Meurer (2009) have stated that in inflation targeting regimes, to decrease inflation to the target level, agents must believe that the central bank commits to the target. Thus, the credibility of the central bank is important for recording low inflation. Furthermore, King (1996) has stated that monetary policy that aims at ensuring price stability must take learning about the implicit inflation target by agents into account and expedite the learning process by making their own preferences explicit.

However, Minella, Freitas, Goldfajn and Muinhos (2003) have indicated that central banks are conducting monetary policy in a forward-looking manner and responds to shocks that cause inflation target misses. They also find that in the low inflation periods, the backward-looking term in the aggregate supply for inflation targeting countries has declined.

The argument of Akerlof (2002) that the degree of attention to a particular variable in expectation formations may depend on the level of the variable is related to the findings of Minella, Freitas, Goldfajn and Muinhos (2003). For example, the effect of realized inflation on the inflation expectations may be high during inflationary episodes. Mishkin (2001) have stated that when inflation is reduced to low levels, inflation has not increased due to the cyclical expansions in the inflation targeting countries.

Holub and Hurnik (2008) have estimated a set of VAR models for Czech Republic to analyze the formation of inflation expectations in the presence of some shocks. They have found that the reaction of inflation expectations is lower relative

to the inflationary effects of shocks.

Başkaya, Kara and Mutluer (2008) have indicated that there is a significant heterogeneity in the process of forming inflation expectations in Turkey. Agents pay attention to both the inflation target and the realization of inflation. However, real sector puts a higher weight to past inflation than the financial sector and an increase in the depreciation of TL leads to higher inflation expectations especially for the financial sector.

Most of the papers have pointed to the importance of credibility of the central bank and introduction of inflation targeting regime on anchoring inflation expectations and thus reducing inflation. They have also marked that some degree of inflation persistence, in other words backward looking behavior in price setting, is an obstacle in front of the central bank to anchor inflation expectations. The paper that is mentioned lastly has stated that agents put some weight to both the actual inflation and the inflation target. Yet, it has highlighted the differences between the real and the financial sector in forming their inflation expectations. However, in this study, after the introduction of inflation targeting regime, the importance of achieving the inflation target for the central banks on controlling inflation expectations will be examined.

### **3.2 The Model and Methodology**

To examine whether there is any difference in the formation of inflation expectations when countries miss their inflation targets, both the linear OLS and the panel generalized method of moments for the same model specification will be employed.

The main model specification in this chapter will be as follows:

$$EXP_{it} = \beta[TAR_{it} ACT_{it-1} TAR_{it} * ITM_{it-1} ACT_{it-1} * ITM_{it-1}] + \varepsilon_{it}$$

where  $i$  is the country indicator,  $t$  is the time indicator,  $EXP$  is expected inflation,  $TAR$  is inflation target,  $ACT$  is actual inflation and  $ITM$  is the value of the inflation target miss. Here,  $TAR*ITM$  is an interaction term that accounts for the effect of inflation target on expected inflation controlling for the level of past period's inflation target miss and  $ACT*ITM$  is an interaction term that accounts for the effect of lagged inflation on expected inflation controlling for the level of past period's inflation target miss.

In addition to this main model specification, another model specification will be employed to check whether putting not the level but the absolute value of inflation target misses will make any difference. In other words, in the absolute value specification, it is assumed that the same weight is given to the undershooting and the overshooting whereas in the level value specification, there is no such assumption. Therefore, the differences between the results of these model specifications will exhibit whether people give the same or different weights to undershooting and overshooting.

The absolute value model specification in this chapter will be as follows:

$$EXP_{it} = \beta[TAR_{it} ACT_{it-1} TAR_{it} * |ITM_{it-1}| ACT_{it-1} * |ITM_{it-1}|] + \varepsilon_{it}$$

The only difference in this specification is that  $|ITM|$  is the absolute value of the inflation target miss.

### 3.3 Data

In this study, inflation targets, actual inflations and inflation expectation survey data

of the 21 inflation targeting countries where 14 of them are emerging market economies that are Brazil, Chile, Colombia, Czech Republic, Hungary, Israel, Mexico, Peru, Philippines, Poland, South Africa, South Korea, Thailand and Turkey and 7 of them are industrialized countries that are Australia, Canada, New Zealand, Norway, Sweden, Switzerland and United Kingdom for the period of 2003-2009 will be used.

All of the data are available at IMF World Economic Outlook (WEO) database, datastream and the central banks of each country.

### **3.4 Estimation Results**

Estimation results of the main model with linear OLS are presented in the Table 4.8 in the appendix. Note that both the  $R^2$  and the adjusted  $R^2$  are 0,88 and 0,87, respectively which are high enough to conclude that the model fits the data well. All of the coefficients are significant at the 10% significance level and the signs of the coefficients are as expected. The coefficient of lagged inflation indicates that 1% increase in the actual inflation causes a 0,47% increase in the next period's expected inflation. The coefficient of inflation target indicates that 1% increase in the inflation target causes a 0,48% increase in that period's expected inflation.

If central bank (CB) achieves its target, then the value of ITM will be zero. Thus, both of the interaction terms will become zero and only inflation target and lagged inflation variables will exist in the regression. From the table of the regression results, it can be seen that the coefficient of inflation target (0,48) is higher than that of the lagged inflation (0,47), meaning that if CB achieves its target, people will put more weight to the inflation target than the lagged inflation.

If CB does not achieve its target, then the value of ITM will be different than zero. Thus, both of the interaction terms will remain in the regression. From the table of the regression results, it can be seen that the coefficient of the interaction term that accounts for the effect of inflation target on expected inflation controlling for the level of inflation target miss is negative, meaning that the total weight put on the inflation target will decrease by 0,03 if CB does not achieve its target. Furthermore, it can also be seen that the coefficient of the interaction term that accounts for the effect of lagged inflation on expected inflation controlling for the level of inflation target miss is positive, meaning that the total weight put on the lagged inflation will increase by 0,02 if CB does not achieve its target.

However, it can also be stated that if CB does not achieve its target, the total weight put on the lagged inflation (sum of the coefficients of lagged inflation and the interaction term for the lagged inflation which is 0,49) will be higher than that of the inflation target (sum of the coefficients of inflation target and the interaction term for the inflation target which is 0,45). This can be interpreted as for the seven years period of 2003-2009 and for these countries, inflation target misses are causing inflation inertia in the short run which leads to a more costly disinflationary monetary policy.

There is an important point to mention that when CB does not achieve its target, the amount of decrease in the weight put on inflation target (0,03) is higher than the amount of increase in the weight put on lagged inflation (0,02). Therefore, the total amount of weight that can cause inflation inertia year by year is 0,05.

Estimation results of the main model with panel GMM are presented in the Table 4.9 in the appendix.

Note that all of the results are same with the estimated model by linear OLS.

Different from the linear OLS model, there are J-statistic and instrument rank. The J statistic is simply the Sargan test statistic that is the value of the GMM objective function at estimated parameters. Here, since the instrument rank of 5 is not greater than the number of estimated coefficients (5), the J statistic of -13,4527 cannot be used to construct the Sargan test of over-identifying restrictions.

Estimation results of the absolute value specification model with OLS are presented in the Table 4.10 in the appendix.

Note that both the  $R^2$  and the adjusted  $R^2$  are 0,875 and 0,872, respectively which are high enough to conclude that the model fits the data well. The coefficients of both the target and the lagged inflation are significant at the 1% significance level. However, the coefficients of the interaction terms are not significant even at the 10% significance level. Therefore, the results may suggest that in the formation of inflation expectations, the weight put on the undershooting is not the same with that of the overshooting. Furthermore, there is some evidence of the asymmetry between inflation target misses in the sense that the weights put on overshooting and undershooting are not the same.

### **3.5 Conclusions**

In this chapter of the thesis, whether there is any difference in the formation of inflation expectations when countries miss their inflation targets is examined with the help of linear ordinary least square estimation for 21 countries for the period of 2003-2009.

The results may suggest that when CB achieves its target, people will put more weight to the inflation target than the lagged inflation. If CB does not achieve its

target, the total weight put on the inflation target will decrease by 0,03 and the total weight put on the lagged inflation will increase by 0,02.

The results may allege that if CB does not achieve its target, the total weight put on the lagged inflation (0,49) will be higher than that of the inflation target (0,45). This can be interpreted as for the seven years period of 2003-2009 and for these countries, inflation target misses are causing inflation inertia which leads to a more costly disinflationary monetary policy.

Furthermore, there is an important point to mention that when CB does not achieve its target, the amount of decrease in the weight put on inflation target (0,03) is higher than the amount of increase in the weight put on lagged inflation (0,02). Therefore, the total weight that can cause inflation inertia year by year is 0,05.

Since the coefficients of both the target and the lagged inflation are significant at the 1% significance level but those of the interaction terms are not, the results of the absolute value model with OLS may suggest that there is some evidence of the asymmetry between inflation target misses in the sense that the weights put on overshooting and undershooting are not the same.

This analysis can be extended in a way that differentiates EMEs and INDs and then runs the estimation model in order to analyze the reasons behind the different performances of the inflation targeting regime in EMEs and INDs.

## CHAPTER 4

### CASE STUDIES OF SUCCESSFUL INFLATION TARGETERS

By examining all of the inflation targeting countries both the emerging market economies and the industrialized countries in detail, it is prominent that countries generally miss their inflation targets by overshooting. However, from the emerging market economies Brazil and from the industrialized countries Switzerland are the successful inflation targeters.

In the time interval that is looked over, Brazil achieved its inflation target in the years of 2004, 2005, 2006, 2007, 2008 and 2009 and Switzerland in 2002, 2003, 2004, 2005, 2006 and 2008 whereas Hungary overshooted in the years of 2003, 2004, 2005, 2006 and 2008 whereas South Africa overshooted in the years of 2003, 2004, 2006, 2007 and 2009 and South Africa in 2002, 2007, 2008 and 2009.

**Table 4.1: Actual and Target Inflation for Brazil in Its Successful Years**

	2004	2005	2006	2007	2008 <sup>4</sup>	2009
<b>Actual Inflation (%)</b>	7,601	5,690	3,141	4,457	5,902	4,312
<b>Inflation Target Band (%)</b>	3-8	2-7	2,5-6,5	2,5-6,5	2,5-6,5	2,5-6,5

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<sup>4</sup> Since the inflation report of Brazil for 2008 and 2009 cannot be found, these years are not analyzed for Brazil.



From the above table for Brazil, it can be seen that the average actual inflation is 5,18% which is not very small. However, I chose Brazil to analyze since it set plausible inflation targets and achieved them.

**Table 4.2: Actual and Target Inflation for Switzerland in Its Successful Years**

	<b>2002</b>	<b>2003</b>	<b>2004</b>	<b>2005</b>	<b>2006</b>	<b>2008</b>
<b>Actual Inflation (%)</b>	0,891	0,594	1,332	1,006	0,621	0,701
<b>Inflation Target Band (%)</b>	0-2	0-2	0-2	0-2	0-2	0-2

From the above table for Switzerland, it can be seen that the average actual inflation is 0,85% which is very small.

**Table 4.3: Actual and Target Inflation for Hungary in Its Overshooting Years**

	<b>2003</b>	<b>2004</b>	<b>2006</b>	<b>2007</b>	<b>2009</b>
<b>Actual Inflation (%)</b>	5,699	5,501	6,500	7,398	5,600
<b>Inflation Target Band (%)</b>	2,5-4,5	2,5-4,5	2-4	2-4	2-4

From the above table for Hungary, it can be seen that it overshooted its inflation targets for those years and the average actual inflation is 6,14% which is high.

**Table 4.4: Actual and Target Inflation for South Africa in Its Overshooting Years**

	<b>2002</b>	<b>2007</b>	<b>2008</b>	<b>2009</b>
<b>Actual Inflation (%)</b>	12,430	8,999	9,500	6,329
<b>Inflation Target Band (%)</b>	3-6	3-6	3-6	3-6

From the above table for South Africa, it can be seen that it overshooted its

inflation targets for those years and the average actual inflation is 9,31% which is very high.

In order to capture the reasons behind being a successful inflation targeter, I analyzed these four countries where two of them are successful and the two of them are not from the perspectives of exchange rate regimes, interest rate regimes, fiscal tightness conditions and capital control conditions. In the capital control conditions title, current account balance, capital account balance, financial account balance, portfolio investment and foreign direct investment (fdi) are examined.

#### **4.1 Exchange Rate Regimes**

The exchange rate movements of the successful inflation targeters that are Brazil and Switzerland in their target achievement years and those of the not successful inflation targets that are Hungary and South Africa in their overshooting years are examined.

In conclusion, a general statement about the appreciation or depreciation of the currencies of the successful inflation targeters cannot be made. However, exchange rate regimes of these two countries are floating as both the Brazil and the Switzerland allowed the value of their currencies to fluctuate. Furthermore, a general statement about the appreciation or depreciation of the currencies of the overshooting inflation targeters cannot be made. Exchange rate regimes of these two countries are floating as both the Hungary and the South Africa allowed the value of their currencies to fluctuate. However, there is a point for South Africa to be mentioned. Its currency depreciated almost all of the years that the inflation target is overshooted. It can be attributed mostly to the limited time to fulfill the necessary preconditions that are emerged from the gradual liberalisation decision of the South

African government of exchange controls after 1994.<sup>5</sup>

## **4.2 Interest Rate Regimes**

The interest rate changes of the successful inflation targeter central banks that are Brazil and Switzerland in their target achievement years and those of the not successful inflation targets that are Hungary and South Africa in their overshooting years are examined.

In conclusion, a general statement about the increase or decrease in the key rates of the successful inflation targeters cannot be made. However, interest rate regimes of these two countries are not supporting the view of the full liberalisation of financial markets. On the contrary, their regimes are interventionist in consideration of both the global and the domestic conditions. However, there is a point that draws the attention for Brazil. In 2005, 2006 and 2007, market interest rates decreased due to the adjusted expectations caused by the convergence of actual inflation and inflation targets. Therefore, it is obvious that Brazil was a successful inflation targeter since it kept the market expectations in control and needed less amount of interest rate interventions. On the contrary, in 2004, Switzerland put more weight on the economic upswing than the price stability and needed more interest rate interventions. Furthermore, a general statement about the increase or decrease in the key rates of the overshooting inflation targeters cannot be made. Also, the interest rate regimes of these two countries are not supporting the view of the full liberalisation of financial markets and their regimes are interventionist in consideration of both the global and the domestic conditions. However, there is a

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<sup>5</sup> This information is taken from the fourth fact sheet of the South African Central Bank titled as “Exchange Rates and Exchange Control”.

point that draws the attention for Hungary. For its overshooting years for 2007 and 2009, central bank entered into an easing cycle and cut the key rates. On the contrary, for these years, it was not expected from Hungarian Central Bank to implement a loose monetary policy. The same criticism can be made for the South African Central Bank in 2008 and 2009.

### **4.3 Fiscal Tightness Conditions**

The fiscal policies of the successful inflation targeters that are Brazil and Switzerland in their target achievement years and those of the not successful inflation targets that are Hungary and South Africa in their overshooting years are examined.

In conclusion, it cannot be suggested that there is a general statement that the successful inflation targeters give government budget deficits or surpluses. However, from the experience of Brazil, it can be understood that successful inflation targeters give budget surpluses or from Switzerland, if they give budget deficits, they at least set some constitutional mechanisms of budget relieving aiming to eliminate current structural deficits. Furthermore, it can be suggested that there is a general statement that the overshooting inflation targeters give mostly budget deficits since for all of the overshooting years for both Hungary and South Africa, except 2007 for South Africa, high budget deficits are recorded.

Besides, there was a good intervention of the Switzerland in 2003. In 2006, the budget deficit as the percentage of GDP decreased due to the constitutional mechanism of budget relieving programme that was set in 2003 aiming to eliminate the current structural deficit until 2007 and making savings by the way of spending cuts. Also, in 2008, the budget deficit turned into a budget surplus thanks to the

commitment to that budget relieving programme.

#### **4.4 Capital Control Conditions**

The capital control conditions of the successful inflation targeters that are Brazil and Switzerland in their target achievement years and those of the not successful inflation targets that are Hungary and South Africa in their overshooting years are examined.

In conclusion, it is seen from the successful inflation targeters, both Brazil and Switzerland that successful inflation targeters give current account surpluses. However, it cannot be suggested that there is a general statement that the successful inflation targeters give financial account deficit or surplus and/or capital account deficit or surplus and/or net inflow of portfolio investment. Furthermore, it is pronounced from the overshooting inflation targeters, both Hungary and South Africa, that overshooting inflation targeters mostly give current account deficits, except for 2009 for Hungary and 2003 for South Africa. However, it cannot be suggested that there is a general statement that the overshooting inflation targeters give financial account deficit or surplus and/or capital account deficit or surplus and/or net inflow of portfolio investment. The point that these four countries did not set a rule for limiting foreign capital both in terms of portfolio investment and foreign direct investment is prominent.

This analysis can be extended in the direction of analyzing the capital control conditions in order to investigate the way how the balance between the current, capital and financial accounts is ensured.

## 4.5 Analyzing The Reasons of Undershooting

By examining all of the inflation targeting countries both the emerging market economies and the industrialized countries in detail, it can be seen that countries rather overshooted than undershooting. However, in some years countries undershooting their inflation targets and the most prominent undershooting countries are Czech Republic and Poland.

In the time interval that is looked over, Czech Republic undershooting its inflation target in the years of 2002, 2003, 2004, 2005, 2006 and 2009 and Poland in 2002, 2003, 2005 and 2006.

**Table 4.5: Inflation Target Misses of Czech Republic in Its Undershooting Years**

	2002	2003	2004	2005	2006	2009
<b>Actual Inflation (%)</b>	0,637	1,055	2,714	2,236	1,690	0,984
<b>Inflation Target Band (%)</b>	3-5	3-5	3-5	3-5	2-4	2-4
<b>Miss (undershoot) (%)<sup>6</sup></b>	3,363	2,945	1,286	1,764	1,310	2,016

From the above table for Czech Republic, it can be seen that the average miss of undershooting is 2,114% for those years.

**Table 4.6: Inflation Target Misses of Poland in Its Undershooting Years**

	2002	2003	2005	2006
<b>Actual Inflation (%)</b>	0,800	1,700	0,700	1,400
<b>Inflation Target Band (%)</b>	2-4	2-4	1,5-3,5	1,5-3,5
<b>Miss (undershoot) (%)</b>	2,200	1,300	1,800	1,100

From the above table for Poland, it can be seen that the average miss of undershooting is 1,6% for those years.

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<sup>6</sup> Inflation target misses are calculated as the differences between the actual inflation and the middle of the target band.

In order to capture the reasons behind undershooting, I analyzed these two countries from the perspectives of exchange rate regimes, interest rate regimes, fiscal tightness conditions and capital control conditions. In the capital control conditions title, current account balance, capital account balance, financial account balance, portfolio investment and foreign direct investment (fdi) are examined.

#### **4.5.1 Exchange Rate Regimes**

The exchange rate movements of these undershooting inflation targeters in their target undershooting years are examined.

In conclusion, a general statement about the appreciation or depreciation of the currencies of the undershooting countries cannot be made. Exchange rate regimes of these two countries are floating since both the Czech Republic and the Poland allowed the value of their currencies to fluctuate.

There was a *good intervention* of the Central Bank of Czech Republic in 2006. In September, Koruna depreciated gradually. At that time the Central Bank of Czech Republic intervened and raised the interest rates and then, Koruna became to appreciate again.

#### **4.5.2 Interest Rate Regimes**

The interest rate changes of these undershooting inflation targeter central banks in their undershooting years are examined.

In conclusion, a general statement about the increase or decrease in the key rates of the undershooting countries cannot be made. However, interest rate regimes

of these two countries are not supporting the view of full liberalisation of financial markets. On the contrary, their regimes are interventionist in consideration of both the global and the domestic conditions.

There was a *good intervention* of the Central Bank of Czech Republic in 2009. The economy was affected by the global financial and economic crisis. Central Bank of Czech Republic intervened and reduced the key rates and thus the market interest rates decreased and the economic activity increased.

#### **4.5.3 Fiscal Tightness Conditions**

The fiscal policies of the undershooting inflation targeters in their undershooting years are examined.

In conclusion, it cannot be suggested that there is a general statement that the undershooting countries give government budget deficit although these two country examples showed that they do. However, from the examples of the Czech Republic and Poland, it can be understood that undershooting countries' public debt can increase but those increases are compensated next year with some presented Acts.

There was a *good intervention* of the Poland government in 2003. In 2002, Poland presented "Draft 2003 Budget Act" in order to reduce the budget spending and the budget deficit. However, in 2003, budget deficit expanded by a substantial amount due to the rise in subsidies transferred to the Social Security and Employment Funds. For this reason, the government did not only present "Draft 2004 Budget Act" but also an extra new reform which is called "Programme of Streamlining and Curbing Public Expenditure" that was aiming to reduce expenditures by envisaging a reform for the social areas that the public funds were



distributed ineffectively. With the help of this programme, Poland reduced its deficit and the growth rate of the public debt in 2005.

#### **4.5.4 Capital Control Conditions**

The capital control conditions of the undershooting inflation targeters in their undershooting years are examined.

In conclusion, it cannot be suggested that there is a general statement that the undershooting countries give current account and/or capital account deficit or surplus and/or net inflow of portfolio investment. However, from the examples of the Czech Republic and Poland, it can be understood that undershooting countries are attracting a substantial amount of net inflow of foreign direct investment. Furthermore, these two countries did not set a rule for limiting foreign capital both in terms of portfolio investment and foreign direct investment.

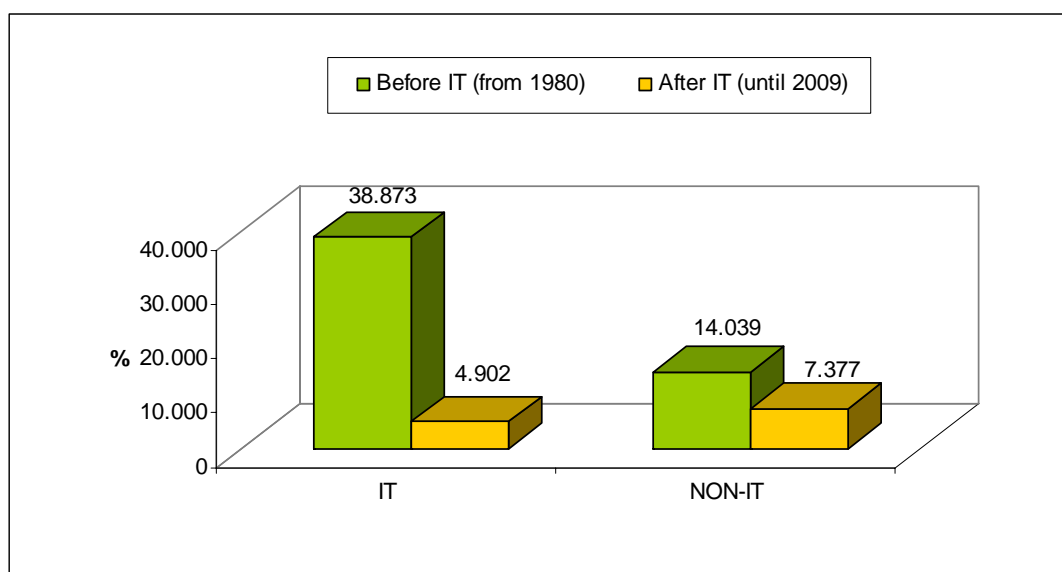
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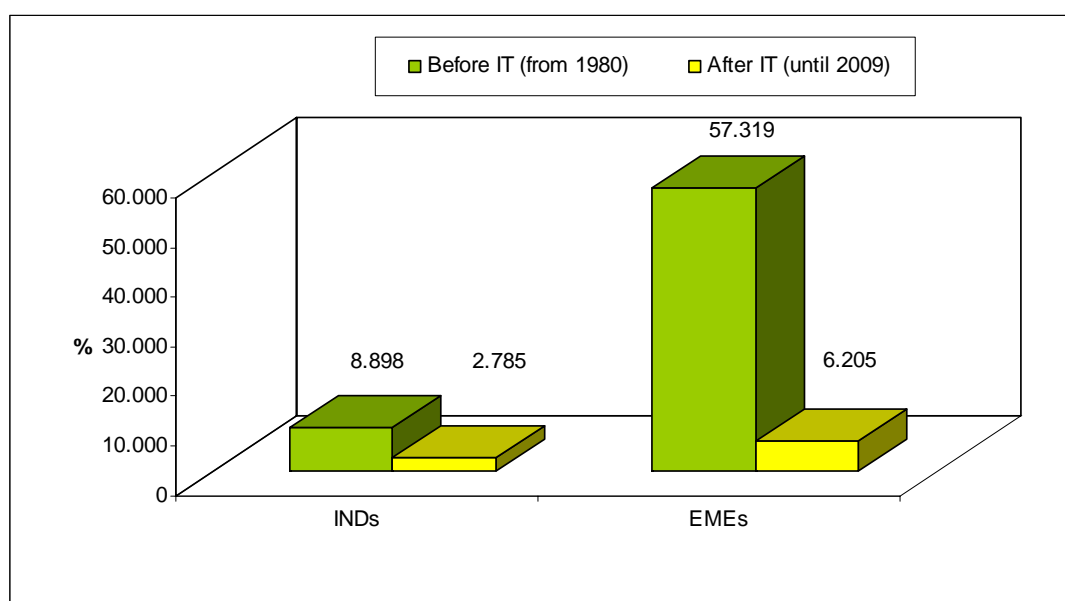
## **APPENDICES**

## APPENDIX A



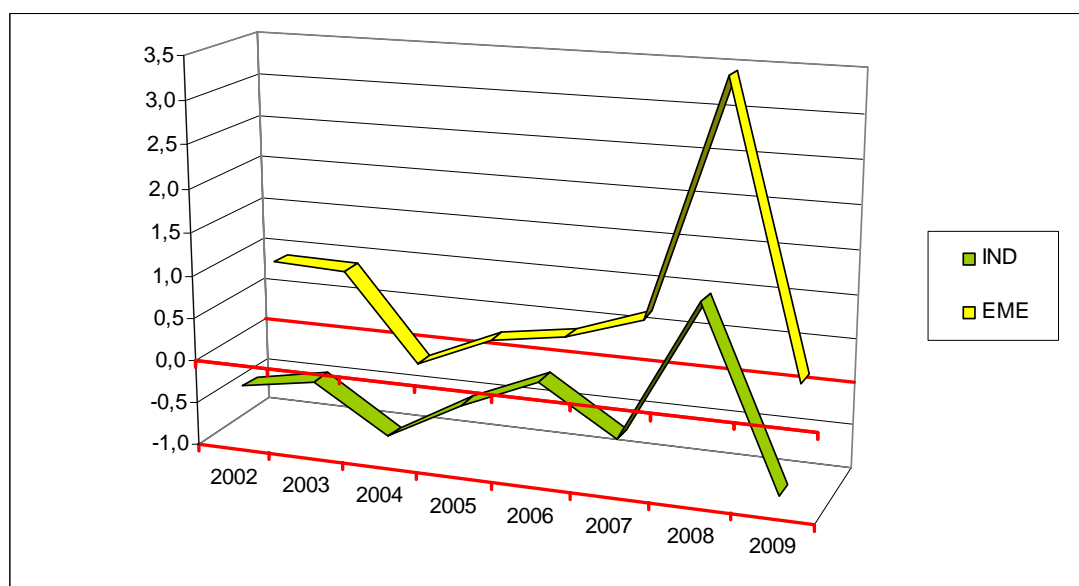
**Figure 1.1: Average Inflation Before and After Adoption of Inflation Targeting**

Source: IMF Database.



**Figure 1.2: Average Inflation Before and After Adoption of Inflation Targeting in EMEs and INDs**

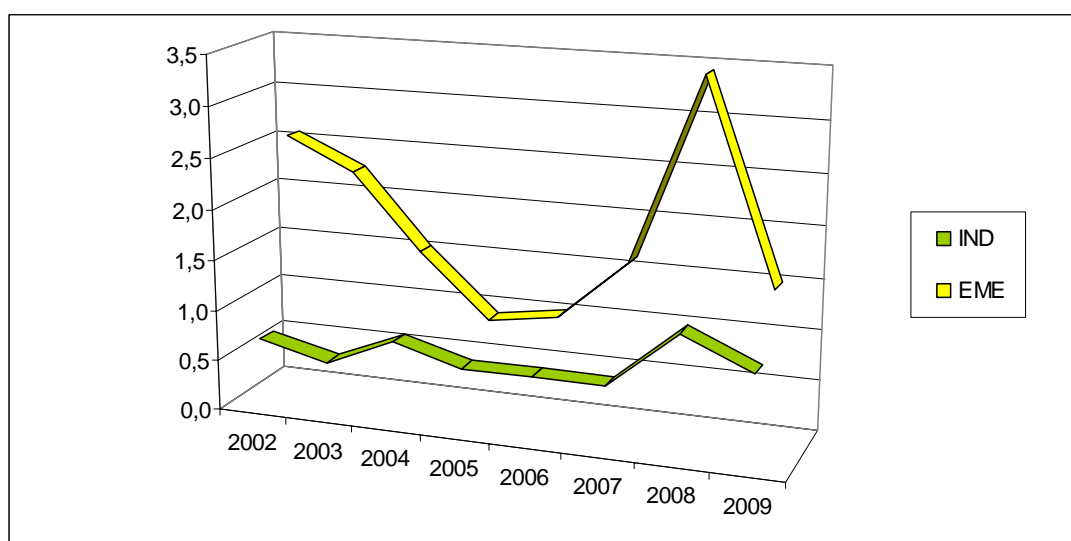
Source: IMF Database.



	2002	2003	2004	2005	2006	2007	2008	2009	Average
<b>IND</b>	-0,3	-0,2	-0,7	-0,3	0,1	-0,4	1,2	-0,8	-0,2
<b>EME</b>	0,9	0,9	-0,2	0,2	0,4	0,7	3,4	0,1	0,8

**Figure 1.3: Average Inflation Target Misses**

Sources: IMF Database and Central Banks of Countries.



	2002	2003	2004	2005	2006	2007	2008	2009	Average
<b>IND</b>	0,7	0,5	0,8	0,6	0,6	0,6	1,2	0,9	0,8
<b>EME</b>	2,6	2,3	1,5	0,9	1,0	1,6	3,4	1,5	1,8

**Figure 1.4: Average Absolute Inflation Target Misses**

Sources: IMF Database and Central Banks of Countries.



## APPENDIX B

**Table 4.7: Estimation Results of the Arellano-Bond Fixed Effects Model**

*Dependent Variable:* ITM

*Method:* Panel Generalized Method of Moments

*Transformation:* First Differences

*Sample (adjusted):* 2004 2008

*Cross-sections included:* 12

*Total panel (balanced) observations:* 60

Difference specification instrument weighting matrix

White period standard errors & covariance (no d.f. correction)

*Instrument list:* @DYN(ITM,-2) EX FIS OIL

<b>Variable</b>	<b>Coefficient</b>	<b>Std. Error</b>	<b>t-Statistic</b>	<b>Prob.</b>
<i>ITM(-1)</i>	0.341248	0.092228	3.700058	0.0005
<i>EX</i>	0.003903	0.002100	1.859038	0.0683
<i>FIS</i>	-0.049540	0.023589	-2.100106	0.0402
<i>OIL</i>	0.029598	0.010534	2.809725	0.0068

### Effects Specification

**Cross-section fixed (first differences)**

R-squared	-0.099678	Mean dependent var	0.380000
Adjusted R-squared	-0.158590	S.D. dependent var	2.697004
S.E. of regression	2.902996	Sum squared resid	471.9336
J-statistic	27.33487	Instrument rank	18.00000

**Table 4.8: Estimation Results of the Main OLS Model**

*Dependent Variable:* EXP01

*Method:* Least Squares

*Sample:* 1 147

*Included observations:* 147

<b>Variable</b>	<b>Coefficient</b>	<b>Std. Error</b>	<b>t-Statistic</b>	<b>Prob.</b>
<b>C</b>	0.355740	0.201996	1.761122	0.0804
<b>TAR</b>	0.485197	0.104683	4.634895	0.0000
<b>ACT</b>	0.479321	0.052147	9.191692	0.0000
<b>TAR*ITMT</b>	-0.035026	0.020322	-1.723514	0.0870
<b>ACT*ITMT</b>	0.022009	0.011432	1.925268	0.0562
R-squared	0.882378	Mean dependent var		3.855102
Adjusted R-squared	0.879065	S.D. dependent var		2.743290
S.E. of regression	0.953998	Akaike info criterion		2.777112
Sum squared resid	129.2360	Schwarz criterion		2.878827
Log likelihood	-199.1177	F-statistic		266.3153
Durbin-Watson stat	1.212795	Prob(F-statistic)		0.000000

**Table 4.9: Estimation Results of the Main Panel GMM Model**

*Dependent Variable:* EXP01

*Method:* Panel Generalized Method of Moments

*Sample:* 2003 2009

*Cross-sections included:* 21

*Total panel (balanced) observations:* 147

*Identity instrument weighting matrix*

*Instrument list:* C TAR ACT TAR\*ITMT ACT\*ITMT

<b>Variable</b>	<b>Coefficient</b>	<b>Std. Error</b>	<b>t-Statistic</b>	<b>Prob.</b>
<b>C</b>	0.355740	0.201996	1.761122	0.0804
<b>TAR</b>	0.485197	0.104683	4.634895	0.0000
<b>ACT</b>	0.479321	0.052147	9.191692	0.0000
<b>TAR*ITMT</b>	-0.035026	0.020322	-1.723514	0.0870
<b>ACT*ITMT</b>	0.022009	0.011432	1.925268	0.0562
R-squared	0.882378	Mean dependent var		3.855102
Adjusted R-squared	0.879065	S.D. dependent var		2.743290
S.E. of regression	0.953998	Sum squared resid		129.2360
Durbin-Watson stat	2.100508	J-statistic		4.63E-26
Instrument rank	5.000000			

**Table 4.10: Estimation Results of the Absolute Value Model Specification**

*Dependent Variable:* EXP01

*Method:* Least Squares

*Sample:* 1 147

*Included observations:* 147

<b>Variable</b>	<b>Coefficient</b>	<b>Std. Error</b>	<b>t-Statistic</b>	<b>Prob.</b>
<b>TAR</b>	0.694726	0.095360	7.285267	0.0000
<b>ACT</b>	0.402643	0.077630	5.186713	0.0000
<b>TARITM</b>	-0.040724	0.027956	-1.456700	0.1474
<b>ACTITM</b>	0.024398	0.017646	1.382623	0.1689
R-squared	0.875513	Mean dependent var		3.855102
Adjusted R-squared	0.872901	S.D. dependent var		2.743290
S.E. of regression	0.978009	Akaike info criterion		2.820238
Sum squared resid	136.7798	Schwarz criterion		2.901611
Log likelihood	-203.2875	Durbin-Watson stat		1.235152